THE GLASS INDUSTRY

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SIMPLIFICATION OF GLASS CONTAINERS BECOMES A WAR NECESSITY

Program to simplify and standardize glass containers is outlined to food packers at National Canners Convention in Chicago.

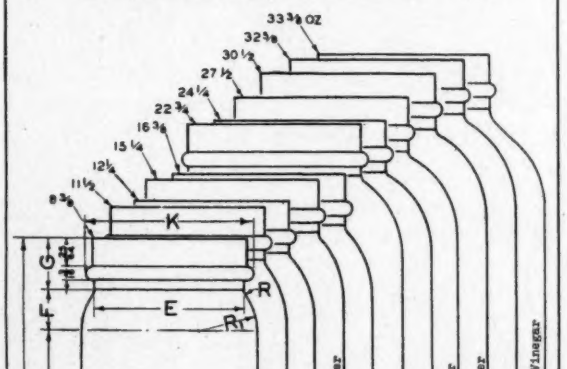
There is nothing new in the idea of standardization of certain types of packaging but it has taken a cataclysmic war to bring to full fruition the idea of simplified, standardized glass containers. While the plans for glass container design submitted to the food manufacturers assembled in Chicago concerned specifically the wide mouth type of container used for packaging products such as jams, jellies, mustard, mayonnaise, pickles, etc., it is certain that other types of glass containers will come in for their share of simplification. This thinking was indicated by remarks made by W. E. Braithwaite of the National Bureau of Standard of U. S. Department of Commerce when he stated in the meeting of the National Preservers Association that brewers and distillers had already indicated their desire to cooperate in simplifying their glass containers.

Mr. Braithwaite, in introducing the subject of the "Economy Line Plain Round Jar" to the preservers and later to peanut butter manufacturers and pickle packers, stressed the extreme urgency of the food packaging situation and also outlined the steps in the development of the simplification program. All glass container manufacturers are no doubt familiar with his message since it was printed as the first page of a four page folder addressed to the users of containers. Included in this folder is a reproduction of the blue-print of the Economy Line Plain Round Jar together with a brief resume of recommended sizes for various products.

A separate questionnaire sheet was also included with this folder, requesting the recipients to indicate the jar and package sizes which they consider as their absolute minimum requirements in the packing of specific products. The form is to be returned directly to Mr. Braithwaite in Washington.

In introducing Mr. Braithwaite to the preservers' convention, Victor L. Hall, Business Manager of the Glass

ECONOMY LINE PLAIN ROUND JAR



Glass technologists state that these jars require 25% to 30% less glass than comparable stock jars now in use; even greater material savings are realized when compared with many private mould jars.

A saving of from 20% to 40% in the metal used in closure manufacture is made possible by the smaller openings or finishes.

The ratio of jar widths to heights permits the most economical packing case resulting in savings of paper board.

RECOMMENDED SIZES

CAPACITY OVERFLOW	8 3/8	11 1/2	12 1/4	15 1/4	16 3/8	22 3/4	24 1/4	27 1/2	30 1/2	32 3/8	33 3/4
Products measured in fluid ounces such as pickles, mayonnaise, relish	1/2 pt.				1 pt.					1 qt.	
Jams, Jellies, Preserves, and Mince Meat			1 lb.				2 lbs.				
Peanut Butter				1 lb.					2 lbs.		
Honey		1 lb.				2 lbs.					

CAPACITY OVER FLOW	WEIGHT	A	B	C	D	E	F	G	K	R	R_1	R_2	R 400 SHOWN 3/32
8 3/8 OZ	5	4 6/32	2.512	11/16	2 3/8	2.125	33/64	45/64	2.312	1/8	5/8	1 1/8	1/32 56MM
11 1/2 OZ	6 1/8	4 25/32	2.750	49/64	2 7/8	2.125	7/8	45/64	2.324	1/8	1 1/4	1 9/32	1/4 56MM
12 1/4 OZ	6 1/2	4 27/32	2.781	49/64	2 1/2	2.125	7/8	45/64	2.324	1/8	1 13/64	1 9/32	1/4 56MM
15 1/4 OZ	7 1/2	5 1/8	3.010	13/16	2 11/16	2.375	59/64	43/64	2.562	1/8	1 3/8	1 23/64	1/4 63MM
16 3/8 OZ	7 1/8	5 5/32	3.090	27/32	2 43/64	2.375	15/16	43/64	2.562	1/8	1 5/16	1 23/64	1/4 63MM
22 3/4 OZ	10	5 7/8	3.460	15/16	3 11/64	2.375	1 1/16	43/64	2.562	1/8	1 5/16	1 1/2	5/16 63MM
24 1/2 OZ	10 1/4	5 61/64	3.531	31/32	3 7/32	2.375	1 1/16	43/64	2.562	1/8	1 5/32	1 15/32	5/16 63MM
27 1/2 OZ	11 1/4	6 1/4	3.679	1	3 25/64	2.375	1 1/8	47/64	2.562	1/8	1 5/16	1 9/16	3/8 63MM
30 1/2 OZ	11 3/4	6 9/16	3.758	1 1/32	3 33/64	2.375	1 3/16	47/64	2.562	1/8	1 1/4	1 5/16	3/8 63MM
32 3/8 OZ	12	6 3/4	3.828	1 1/16	3 45/64	2.375	1 1/4	47/64	2.562	5/32	1 19/64	1 3/4	3/8 63MM
33 3/4 OZ	12 1/8	6 13/16	3.859	1 3/32	3 45/64	2.375	1 5/32	47/64	2.562	1/4	1 9/64	1 21/32	3/8 63MM

NOTES:

1. ANY STANDARD G.C.A. GLASS FINISH SUITABLE TO THE JAR BODY MOLD MAY BE USED.
2. FOR FINISHES OTHER THAN THE SPECIFIED G.C.A. NO. 400 SHALLOW CONTINUOUS THREAD USE COMPARABLE SIZES TO G.C.A. NO. 400 AS SHOWN BELOW

G.C.A. 400	G.C.A. 140	G.C.A. 800	G.C.A. 1400	G.C.A. 1700	G.C.A. 3900
58	58	58	63	55	58
63	63	63	66	60	63

Container Association read a letter from Wayne C. Taylor, Under Secretary of Commerce which indicated that the original impetus for the present effort had come from the Office of Production Management. Following is Mr. Taylor's letter:

DEPARTMENT OF COMMERCE
OFFICE OF THE UNDER SECRETARY
WASHINGTON

September 11, 1941

Dear Mr. Hall:

During recent months the brewers of beer and the distillers of whiskey have been in touch with the National Bureau of Standards of this Department, in regard to the simplification of bottles and containers. There has also been discussion within the Office of Production Management during recent weeks, relative to standardization of whiskey bottles. These developments have stimulated discussion of a broad simplification program for glass containers generally.

It is my belief that among other contributions the Department of Commerce can make to the National Defense Program is the encouragement of manufacturers and distributors in the conservation of machinery, power, effort, and materials. Likewise, the manufacturers of glass containers are in a key position to stimulate and foster such thinking and planning on the part of their customers, and to do so with the conviction that a sensible and timely reduction in bottle-sizes, shapes, and capacities is good management and will be a real contribution to the Defense Effort.

As you know, in years past the Department has approved the promulgation, by the National Bureau of Standards, of Simplified Practice Recommendations covering glass containers for a number of commodities, with measurable advantages to glass container manufacturers, packers, wholesalers and retailers, and the public. I believe that the present is an excellent time for the Bureau of Standards and glass container manufacturers to explore, jointly, additional simplification measures which might be undertaken.

It would be appreciated if you would bring this proposal to the attention of your members and advise me of their reactions.

Sincerely yours,
(signed) WAYNE C. TAYLOR
Under Secretary of Commerce

While the whole idea of simplification of design and the reduction of the number of sizes was presented to the preservers with a request for voluntary cooperation, Mr. Braithwaite significantly pointed out that if cooperation on the part of packers was not achieved it might very well be that the Government may make the adoption of simplified, standardized containers mandatory. Peanut butter manufacturers and pickle packers subsequently voted to ask the War Production Board to make the program compulsory by a directive order.

There was a good deal of discussion as to sizes of containers for various products and the question of whether or not the simplification program would apply to packers tumblers. Mr. John S. Algeo of Hazel-Atlas Glass Company was called upon by Mr. Hall to answer these questions.

Mr. Algeo stated that his company is drawing up a broad program of simplification but that nothing definite has been done with regard to tumblers as yet. He stated however, that if the preservers felt that a standardized tumbler line was necessary, it would be forthcoming. Quite aside from the great increase in the production of containers which the Economy Line Plain Round Jar will provide and which is absolutely essential to the war effort, are the equally important benefits which this type of container will permit in the conservation of certain raw materials. The advantages of this new glass container ware in the light of the present emergency can be summed up briefly as follows: that the simplified glass containers will create an enormously increased gallonage or packaging capacity per ton of glass with a substantially reduced consumption of vital raw materials.

In connection with this latter phase of the benefits of simplification a few of the highlights presented by Mr. Algeo are worth noting. For example, only two sizes of caps would be necessary for line as it was presented, indicating not only a speeding up of closure production but a reduction in waste. Caps for the new jar offer about a 21 per cent reduction in tin plate over the present Army Jar closure size, and as compared to the deep 70 millimeter—G Cap there is an economy of approximately 43 per cent of the same material. Parenthetically, it may be mentioned, that Mr. W. L. Walde of the National Preservers Association stated that the Army was ready to accept the Economy jar in place of the present Army Table-Serve containers.

By virtue of a reduction in the weight per container a decided saving in vital soda ash will be achieved. Less fuel should be required for firing tank furnaces per gross of glass containers produced and last but nevertheless of great importance, a definite saving in paper board for shipping containers will be effected. Mr. Braithwaite strongly employed this point and also urged packers to adopt a standard unit of pack to further conserve paper.

In discussing the length of time it would take for a complete change-over to the simplified jar Mr. Algeo stated as far as he knew all glass container manufacturers who are equipped to produce wide mouth ware are now acquiring the necessary mould equipment. However, it is recognized that as in all major changes where mass production is involved there must be a transition period. The packers have one set of problems and the glass makers another and in this connection Mr. Braithwaite said he had two dates in mind for the transitional period. And the time element for each group would be determined by their respective problems. Glassmen are doing everything possible to hasten the transition and with the proper cooperation from the packers final accomplishment will be attained reasonably soon.

JUDGE VOIDS SUITS AGAINST B&L

Federal Judge Alfred C. Coxe on January 16 dismissed the $40,000,000 suit brought by Murray Brensilber and Samuel Thibner, New York lawyers, against Bausch & Lomb Optical Company; Carl Zeiss, Inc., and three B&L executives, M. Herbert Eisenhadt, Carl L. Bausch and Theodore B. Drescher. The case was brought under an old Civil War statute and Judge Coxe, after hearing argument, said he was convinced that the statute, which authorized citizens in cases of fraud against the government to bring suit for double damages on behalf of the United States and themselves, "does not apply to this case, nor to anti-trust proceedings."

Whitney Seymour, attorney for Bausch & Lomb, said that Judge Henry W. Goddard, before imposing fines in a government proceeding under the Sherman anti-trust law against the same group of defendants, had asked whether there was evidence of fraud and had been told there was not. He noted, too, that a plea of *nolo contendere* had been entered in the anti-trust case.

THE USE OF CULLET—A REVIEW

In these days of priorities and shortages, the glass industry, especially the container branch, is giving much thought to the subject of raw materials. The general opinion throughout the industry seems to be that if shortages do not become too serious, production can be kept at a satisfactory level by the use of increased amounts of cullet along with the batch.

The ratio of cullet to batch used by the different branches of glass making varies over wide limits. Figures presented at the 1935 Urbana Glass Conference[1] and given in Table I show the range then in use by the various branches. In the container field the general trend has been towards the lower range and it is this branch of the industry that can stretch their basic raw materials the greatest by increasing the amount of cullet used. For example, Fig. 1 shows graphically the influence of a cullet increase on the soda requirements based on a ton of glass made from a simple soda-lime-silica container glass. The other batch materials are also influenced in a like manner.

It is the purpose of this review to present an overall picture of the results and opinions which have been obtained by research and observation on the use of cullet and which have been reported in the literature. In most cases the published material has been briefly abstracted and condensed and if it is desired to study the subject in more detail, certain of the more pertinent references have been listed. In the subject groupings that follow it will be found that there is an overlapping of subject material. This is due to the fact that most of the workers who have covered this subject have been interested in more than one phase of the subject.

The Effect of Cullet on Melting and Fining

McSwiney[2] states that cullet when mixed with the batch does not act as a flux but acts as a diluent and thereby decreases the tendency towards batch scum. It would therefore seem that for the same tonnage pull on a furnace that the melting temperature could be lowered as the percentage of cullet in the batch mix is increased or if the temperature is kept constant that the rate of melting could be increased. Work by Turner[3] on pot melts of soda-lime-silica glasses in which the cullet content of the batch mix was varied from 0 to 100 per cent showed that in one series of glasses no difference in the melting rate could be noted when the cullet was increased from 0 to 40 per cent, beyond 40 per cent it was found that the rate of melting was slowed down. In three other series of tests it was found that increases in cullet resulted in an increase in the rate of melting. This is shown in Fig. 2. In all of the series the rate of fining increased as the cullet was increased. Kiigler[4] working with a soda-lime-silica glass found that a cullet increase from 30 to 40 per cent did not change the melting time but that more than 40 per cent produced a decided retardation when melting at 1400°C. At 1350°C a 40 per cent cullet batch required a longer melting time than did a 33⅓ per cent batch. The refining time was lowest with 30-40 per cent cullet, below or above this range it was increased.

TABLE I

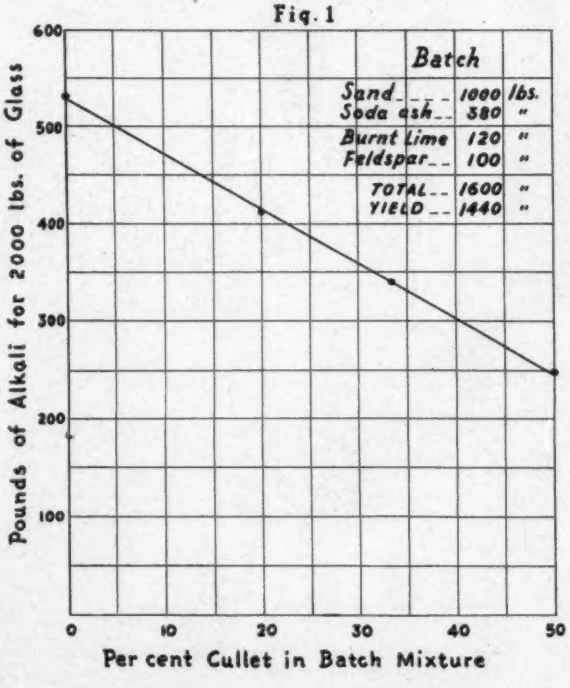
Branch of the Industry	Amount of Cullet in batch Min. %	Max.%
Miscellaneous	25	75
Thin Blown Ware	15	75
Rolled Glass	10	80
Window Glass	20	80
Containers	10	52

Both Turner[3] and Kiigler[4] found that the method of preparing the cullet, i.e., dry or water quenched did not influence the melting or fining rate. According to Turner[3] seedy cullet did not seem to affect the rate of fining. Besborodov[5], in a study of the influence of the grain size of the cullet, found that with the finest cullet the amount of reaction was greatest while with the larger grain size cullet the amount of reaction was the least.

Influence of Cullet on Working Properties

In regards to the influence of cullet on the working properties of glass Scholes[6] states: "Skilled glass workers and operators of machines seem to be able to notice differences in the working properties or nature of the glass, according to the proportion of cullet that is being used, even when the cullet is produced from the same tank and may be expected to have the same composition as the normal glass. When little or no cullet is used the glass is softer working, that is, its viscosity is lower. When the cullet ratio is high, the glass seems stiffer or higher in viscosity." Turner[3] makes the same statement and in his investigations found that as the percentage of cullet was increased a corresponding decrease in the working range and an increase in the working viscosity of the glass took place. These changes are believed due to both the loss of alkali and removal of dissolved gases that occurs when glass is remelted. In practice these changes are taken care of and corrected for by either increasing

Fig. 1



the working temperature of the glass so as to overcome the effect of increased viscosity or by the addition of small amounts of alkali to the batch to compensate for the increased viscosity.

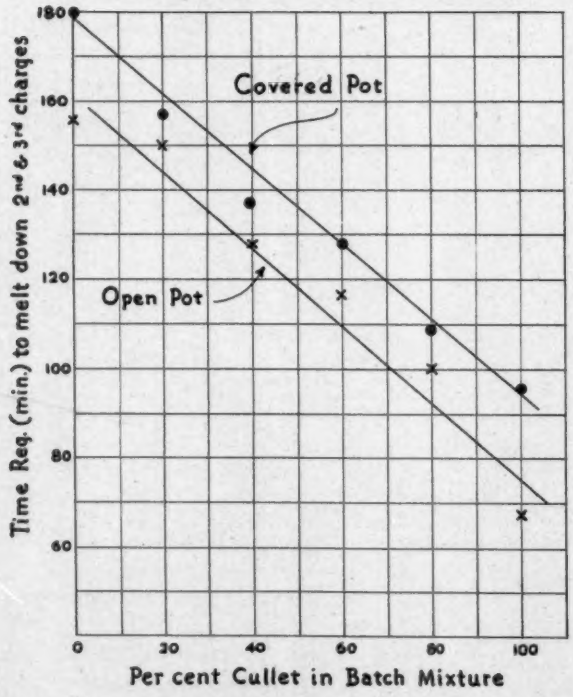
Turner and his co-workers[7] in their studies on the influence of the addition of small amounts of alkaline salts on the ease of melting and on the working properties of glasses prepared from cullet found that the most effective salts for producing easy melting and refining, good working properties and least corrosion were soda ash and borax. Glasses prepared from 99 parts of cullet and one part soda ash became plain before similar glasses prepared from batch and cullet. Richardson[8] also reports that a batch consisting of 98 per cent cullet (soda-lime bulb glass) used for electric lamp bases was exceedingly difficult to melt until 4 lbs. of ammonium sulphate per 1000 lbs of batch materials was added.

The Influence of Cullet on Physical and Chemical Properties

Besborodov[9], using a series of experimental meltings containing amounts of cullet in the batch mixture which varied from nil to 80 per cent cullet, studied the influence of cullet on certain physical properties such as thermal expansion, thermal endurance, chemical durability and lamp working stability. All the changes found could be accounted for by the changes in chemical composition. That glass on remelting does not undergo mysterious changes that cannot be accounted for has been conclusively proven by Turner[10] who showed that there was no change in the X-ray pattern of a glass after repeated meltings in platinum.

Of greater interest is the subject of the influence of cullet on the brittleness of glass. The term "brittleness" in this case is usually meant to imply breakage due to inhomogeneity. Hyslop[11] in his investigations on the influence of cullet on the brittleness of opal glass made a series of melts under the same melting times and conditions. Each melt contained 60 per cent cullet but its grain size varied in each melt as follows: ¼ to ⅛ inch, 10-20 mesh, 90-120 mesh and 200 mesh. It was found that the large grain size cullet gave a heterogeneous product and as the cullet size decreased the structure of the glass improved and the impact brittleness was also improved. An anon. writer in Glashutte[12] states that the size of the cullet influences brittleness as large pieces of cullet cause unhomogeneous glass. This writer also describes a series of practical experiments made in a pot furnace. A series of melts were made in which the amount of cullet was varied in steps of 30 parts cullet per 100 parts sand from zero parts cullet to 150 parts cullet to 100 parts of sand. Ware made from these melts was practically identical (as far as breakage tests were concerned) even when checked after 3 months' storage. Currie[13] states that cordiness due to cullet is minimized if the cullet is crushed to a size comparable with that of the other batch materials and if the cullet so crushed is intimately mixed with the batch. He also claims that large lumps of cullet sink in the hot tank metal when charged in and lift the lighter batch on top thus causing two layers of different viscosities which do not mix. When this glass is worked out a large percentage of breakage is experienced. Uhrmann[1] also states that when cullet is used in large lumps difficulties are likely to arise from inhomogeneity and recommends that the cullet be crushed before being added to the batch preferably to ½ inch to 1 inch mesh size.

Fig.2
Influence of Cullet on the Melting of Soda-Lime-Silica Batches



Cullet as a Raw Material

If an increase in the amount of cullet to batch is being contemplated it will be found in most cases that it will be necessary to purchase cullet from cullet or junk dealers. Such purchased cullet will be found to be a mixture of all sorts of glass types and compositions. Several years ago most glass container compositions were similar and the use of purchased cullet presented no great problem. In the past few years this situation has changed, several different container compositions now being in use.

Purchased cullet must therefore be considered as a raw material just as is feldspar or limestone but varying in composition more greatly than do these two materials. The composition of each lot of cullet must be taken into account if troubles due to chemical and physical property variations are to be minimized. Lyle[14] has given the procedure required for such calculations and the following is taken directly from his paper:

For example, a certain lot of cullet may have the following analysis:

SiO_2	73.5
R_2O_3	0.7
CaO }	9.3
MgO }	
Na_2O	16.5

This cullet is to be used in a batch to produce glass of the following composition,

SiO_2	74.8
R_2O_3	1.6
CaO }	6.5
MgO }	
Na_2O	17.1

The changes necessary, and the method of calculating them, are shown in the tabulation.

	Composition Desired	—	Composition Cullet	=	Necessary Change
SiO_2	74.8	—	73.5	=	+1.3
R_2O_3	1.6	—	0.7	=	+0.9
CaO / MgO	6.5	—	9.3	=	−2.8
Na_2O	17.1	—	16.5	=	+0.6

It is seen that it is necessary to add silica, R_2O_3, and soda while the total of lime plus magnesia, must be decreased. These changes can be calculated just as if they comprised a glass composition, except that attention must be given to whether the material is to be added or subtracted from the batch.

Order of Calculation	Change	Correction	Calculation	Amount of Material	Add. Oxides
(1) R_2O_3	+.09		$0.9 \times \frac{100}{17.5} = +5.14$	*Feldspar*	
					$5.14 \times .688 = -3.54$ SiO_2
					$5.14 \times .004 = -.02$ CaO
					$5.14 \times .129 = -.66$ Alkali
(2) CaO-MgO	−2.9		$-2.9 \times \frac{100}{52.1} = -5.57$	*Dolomite*	
(3) SiO_2	+1.3−3.54 (from feldspar) = −2.24		$-2.24 \times \frac{100}{99.6} = -2.25$	*Sand*	
(4) Na_2O-K_2O	+0.6−0.66 (from feldspar) = −0.06		$-0.06 \times \frac{100}{58.5} = -0.10$	*Soda Ash*	

Collecting the items italicized in the table, the changes for 100 pounds of cullet are: Sand —2.3 pounds, Soda Ash —0.1 pound, Dolomite —5.6 pounds, Feldspar +5.1 pounds.

If it is decided to use 350 pounds of this cullet in the batch, the alterations to the batch are obtained by multiplying each correction by 3.50.

Material	Calculation	Correction
Sand	−2.3 x 3.50	= −8.0 pounds
Soda	−0.1 x 3.50	= − 0.4 "
Dolomite	−5.6 x 3.50	= −19.6 "
Feldspar	+5.1 x 3.50	= +17.9 "

The corrections indicated, when added to the original batch will give the corrected batch formula.

	Original Batch	Change	Batch with Cullet	1000 lb. Corrected Batch	Final Rounded
Sand	1000	− 8.0	992.0	1000	1000
Soda Ash	380	− 0.4	379.6	383	385
Dolomite	175	−19.6	155.4	157	155
Feldspar	100	+17.9	117.9	119	120
Saltcake	10	..	10	10	10
Arsenic	5	..	5	5	5
Nitre	10	..	10	10	10
Cullet	none	+ 350	350	353	350

In order to check this calculation, the batch, including the cullet, can be calculated to the glass composition it will produce, and further corrections made if necessary.

In the case of cullet containing oxides not present in the regular glass composition, some allowances will have to be made. For instance, cullet may contain barium and boric oxide that are not present in the original batch, or the ratio of lime to magnesia may be different. In general, such cullet cannot be used, but if the amounts or differences are small the lime, magnesia and barium may be totaled and the calculations made as total lime. For purposes of calculation, boric oxide can be added to the alkali, if the amount of cullet to be used is not very large. In many bottle glasses the ratio of lime to magnesia, or the amount of magnesia, can be varied within certain limits so that cullet containing little or no magnesia can be used.

General

The storage of both purchased and factory cullet is usually a problem in most glass factories since contamination by tramp metal or iron from abrasion and by dust and dirt is a frequent source of trouble. These contaminates may be kept at a minimum, if the cullet is moved as fast as possible and the factory cullet and purchased cullet kept in separate storage binds.

All cullet should be magnetically treated if good color is desired and dirty cullet should be washed to free it from organic impurities. If washed, the cullet should be dry as wet cullet is likely to cause trouble. Wet cullet when added to the batch at the mixer will cause the soda ash to cling to the cullet instead of mixing uniformly with the batch ingredients. Since it is the sand which most needs the fluxing effect of the soda, this retention by the cullet is a detriment to the melting.

Once a suitable cullet to batch ratio has been found it should be kept as constant as is possible. Cullet supplies must be so planned that sufficient stocks are always on hand. If the cullet to batch ratio must be changed it should be done in small changes rather than all at once if extreme cordiness is to be prevented. Every change in cullet ratio should be watched closely and the resulting glass checked for composition changes and cordiness by suitable methods.

[1]Conference on Glass Problems, 1935, at Urbana, reported in THE GLASS INDUSTRY, July, 1935.
[2]D. J. McSwiney, THE GLASS INDUSTRY, 1926, 7, 66.
[3]W. E. S. Turner, *Jour. Soc. Glass Tech.*, 1929, 13, 25, 37.
[4]K. Kiigler, *Glashutte*, 1937, 67, 467.
[5]Besborodov, *Jour. Soc. Glass Tech.*, 1936, 20, 95.
[6]S. R. Scholes, Modern Glass Practice, Rev. Ed., 1941, Industrial Publications, Inc., Chicago.
[7]W. E. S. Turner, *Jour. Soc. Glass Tech.*, 1929, 13, 47.
[8]H. K. Richardson, THE GLASS INDUSTRY, 1935, 16, 8, 233.
[9]Besborodov, *Keraniko i Steklo*, 1931, 4, 11; 1931, 9, 6.
[10]W. E. S. Turner, *Jour Soc. Glass Tech.*, 1930, 14, 351.
[11]J. F. Hyslop, *Jour Soc. Glass Tech.*, 1927, 11, 368.
[12]Anon., *Glashutte*, 1930, 60, 21.
[13]J. Currie, *Glass*, 1927, 4, 243.
[14]A. K. Lyle, THE GLASS INDUSTRY, 1937, 18, 9.

AMA MARKETING CONFERENCE

A conference to discuss the wartime problems of selling organizations in the industrial and consumer fields will be held March 4 and 5, it has been announced by the American Management Association. The Conference will be sponsored by the Marketing Division of the Association under the direction of Leonard J. Raymond, President, Dickie-Raymond, Inc., and H. R. Chapman, Vice President, New England Confectionery Company, Vice Presidents in charge of the Division. The sessions will take place at the Hotel Roosevelt, New York City.

THE TOLEDO TRIAL

Taking of testimony in the antitrust suit against major glass container manufacturers, being heard in Federal Court in Toledo, Ohio, ended Jan. 21 during the 26th week of the trial.

Judge Frank L. Kloeb will hear arguments on motions of five defendant corporations seeking dismissal of charges and on June 27 court will reconvene for final arguments of defendants who have not asked a directed verdict.

In the meantime the numerous counsel for the defendants and for the government face the huge task of compiling trial notes and accusations for the preparation of briefs. The schedule agreed upon at the adjournment of court calls for presentation of the government's briefs not later than April 4. The answering briefs of the defendants will be filed on or before May 29 and the reply briefs of the government on June 20. Counsel will then have one week to polish argument material. Judge Kloeb warned all counsel that the trial has had many delays and much time has been lost through continuances and he declared that he will not grant additional time prior to arguments. He said he wants the arguments concluded before July 4.

The summary of the trial, which began March 3, 1940 and was interrupted by summer and Christmas vacations and an occasional week or two by other matters, shows that there were 26 weeks of actual testimony; that the government introduced 2,031 exhibits and the defendants, 1,190; there were 48 government witnesses, including four on rebuttal, and 28 appeared for the defense; the stenographic record contains approximately 10,600 pages.

Some witnesses were on the stand only as long as two or three minutes while others spent many days, the record being held by F. Goodwin Smith, president of the Hartford-Empire Co., Hartford, Conn., whose testimony took 20 days to record. The record for being recalled to testify is held by Vernon M. Dorsey, Hartford patent counsel, who was summoned five times.

The defense of the Owens-Illinois Glass Co., Toledo, highlighted the January testimony and counsel for the company presented an interesting picture of the growth of the industry. Particularly interesting was the story of Richard LaFrance, Toledo, who retired as chief engineer of the old Owens Bottle Machine Co., in 1923. His testimony revealed that Michael J. Owens, the Toledo glass machinery inventor whose ideas helped revolutionize one of the world's greatest industries, died without seeing his greatest bottle-producing machine work. He died without knowing that he perfected a machine which turned out medicinal bottles with such rapidity that its use had to be discontinued because the production was greater than the market. Mr. Owens' dream was a machine with a tremendous bottle output and that machine went into operation shortly after the inventor died in 1923, Mr. LaFrance testified. It was a 20-mold machine, and produced 300 four-ounce prescription bottles a minute, he said. Its output was so great, he added, that the use of the machine was halted after two or three years because bottles were being produced too fast for sale. Of all the Owens machines it was the greatest, the witness said.

Mr. LaFrance also traced the pioneer glass days when bottles were made by hand, then compared that era with the semi-automatic glass machine period when it was a feat for a crew of five men to turn out five or six bottles a minute.

The testimony of John H. McNerney, secretary-treasurer of Owens-Illinois, linked together two of the greatest names in the glass industry—those of Mr. Owens and the late Edward Drummond Libbey. The adventures of these pioneers in a business which brought the city of Toledo international recognition was recounted by Mr. McNerney principally from records and notes, since he was not associated with the men in their early history.

Soon after Mr. Libbey brought the Libbey Glass Co. from East Cambridge, Mass., to Toledo he and Mr. Owens, whose mind had turned to the glass container industry, became exceptionally fine friends and before long were associated in the business of the Libbey company. Mr. Libbey furnished the money for the promotion of Mr. Owens' ideas and in a short time they had the old Toledo Glass Co. functioning smoothly, amazing the glass industry with its perfect production of lamp chimneys, tumblers and electric bulbs, Mr. McNerney testified.

He continued that Mr. Owens' famous bottle machine drew nation-wide attention and in short order were being installed in major glass plants throughout the country.

The first license for outside use of the machine was issued in 1903 to the former firm of Baldwin & Travis, now the Thatcher Mfg. Co., one of the world's leading producers of milk bottles. The first license cost Baldwin & Travis $250,000, according to the records. Of that sum $150,000 was paid in cash and the remainder taken out in stock, $50,000 in preferred and a like amount in common.

Owens machines were so efficient, according to the testimony of John P. Tassick, Columbus, Ohio, retired glass plant manager, that the type of machine installed in plants in 1913 were still being installed when he retired in 1933.

The Owens' defense, which occupied the greater part of the January testimony, developed that Owens has spent $32,000,000 for physical improvements in its various plants since 1935. Mr. Samuel S. Isseks, chief government counsel, agreed to stipulate that certain improvements and expenditures were made after Henry Middleton, counsel for Owens, sought to introduce such testimony through John E. McLaughlin, Alton, Ill., superintendent of mechanical engineering developments for the company there.

Mr. Middleton introduced figures to explain the company's rehabilitation program, offered to show that Owens-Illinois expanded its interests and developments rather than stifled them.

The huge mechanical engineering division which Owens maintains at Alton has been operated at large costs since 1934, Mr. Middleton said, and great sums were expended in the development of various container producing machines and costly units for other machines. In 1934 the engineering division cost was $75,000, he said; in 1935 it was $140,000; 1936, $215,000; 1937, $254,000; 1938, $164,000; 1939, $222,300; 1940, $177,500 and 1941, $151,000.

(*Continued on page* 72)

INVENTIONS AND INVENTORS

A Summary of United States Patents of Interest to the Glass Industry Issued During December

Compositions

A recent patent granted to George J. Bair of Pittsburgh suggested as another use for the waste sand and powdered glass obtained from plate glass polishing, that it be heated to the sintering point and then pressed to form strong tiles or blocks. He now reports in patent 2,264,-499 assigned to Norbert S. Garbisch, that these products can be improved by applying a dry powdered glaze while they are hot. Only slight additional heating is needed to fuse the glaze.

Delcomania designs are made by Marco A. Ciavola of Detroit (2,267,787) by squeegeeing colors including powdered glass through silk screens onto transfer paper.

Furnaces

Joseph Romazzotti has obtained a patent on an electric glass furnace wherein the electrodes are immersed in the liquid to melt and heat the glass by the passage of electric current through it. The novelty of the furnace is concerned mainly with the placement of electrodes. As shown in Fig. 1 certain pairs of electrodes such as 20 and 21 are set at such an angle as to converge at the center of the furnace so as to produce the hottest zone at that place, and to avoid over-heating the side walls. The doghouse is at the right and drawing is from the other end. An item of interest concerning the patent is the fact that the inventor lives in Versailles and that he was able to file this application Dec. 12, 1940, after the German invasion. It is assigned to Societe Anonyme des Mfg. des Glaces & Produits Chimiques de Saint-Gobain, Chauny & Cirey, Paris.

Feeding, Forming and Shaping

In a process for continuously drawing glass tubing vertically from a reservoir of molten glass, George P. Despret of Paris, France, places an air nozzle of intricate design at the meniscus or drawing point to cool the inside of the tube. Air is supplied to the nozzle through a conduit brought up through the glass bath; patent 2,267,554 is assigned to Campagnies Reunies des Glaces et Verres Speciaux du Nord de la France, Nord, France.

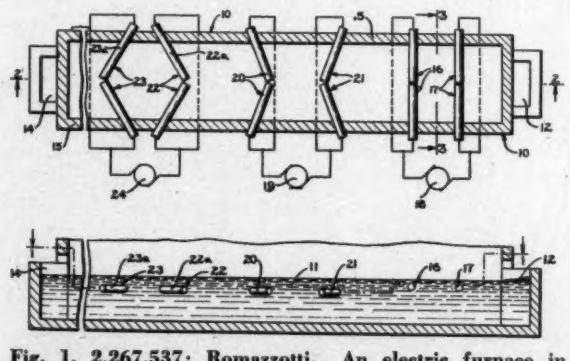


Fig. 1. 2,267,537: Romazzotti. An electric furnace in which some of the electrodes such as 20, 21, are brought closer together at the center of the furnace to increase the intensity of heating.

Fig. 2 illustrates the apparatus designed by Walter C. Weber of Painted Post, N. Y., for reshaping the edge of glass articles, (2,266,484, Corning Glass Works). He tried to avoid any wiping action which might scratch the glass, and instead provided the shaping tool 45 with a rocking motion so that when it presses forward to put a bead or lip on the glass article 21, there is no relative movement between the tool and the glass which it contacts. Gas burners 15 soften the article for shaping.

Patent 2,266,417 granted to Charles Eisler of South Orange, N. J. is also concerned with a machine for shaping tubular glass articles. The tubes, held upright at various stations on a rotary table, advance to the reshaping point where a tool outside the tube bears against the glass to shape it against another tool which has entered the tube. Both tools rotate.

Godfrey P. Goode of Covington, Ky. (The Lackner Co. Inc.) received patent 2,265,070 for a tube bending device which supports the tube in a frame while the area of the bend is heated, and then allows the tube to be bent manually to any desired predetermined angle.

Figure 3 from patent 2,265,414 illustrates the means devised by John R. and Wm. F. Beers of Jeannette, Pa. (McKee Glass Co.) for controlling the size of gob fed to the molds of a tumbler press. The left hand portion of the illustration shows a rotary table with a tumbler being pressed in the left hand mold 2 by plunger 4. The view at the right is of the feeding apparatus. If the charge is too small or too large the plunger will move an abnormal distance into the mold and will operate switches to light either one or another signal light to show the operator that the charge is either too small or too large. The operator will then press the proper switch to start a reversible motor 12 which can either retard or lift the sleeve 7 to modify the gob weight. The signal light goes off when the weight correction has been made. By tapping one switch or the other to reverse the motor the operator may make fine adjustments.

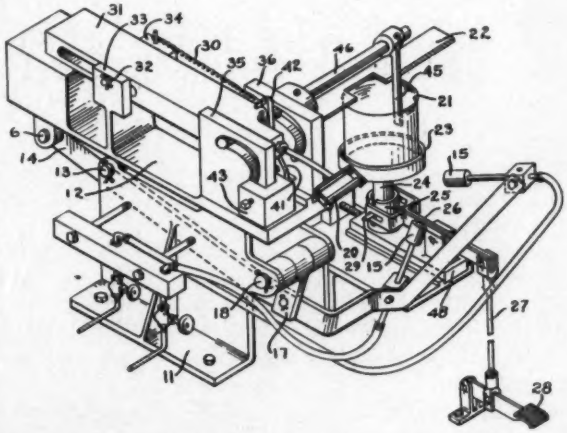


Fig. 2. 2,266,484: Weber. In reshaping ware 21, the shaft 46 rocks so as to turn the tool 45 over the edge of the ware without rubbing it.

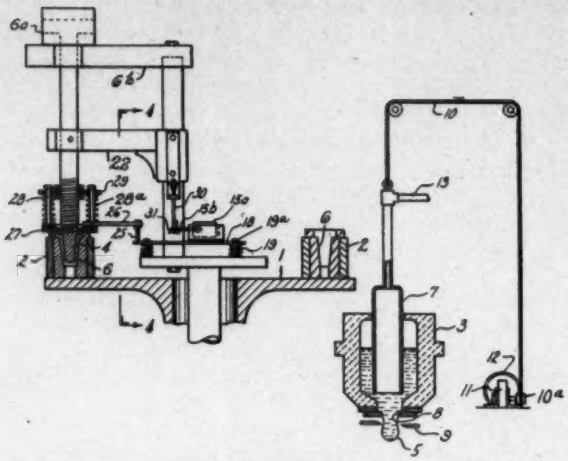


Fig. 3. 2,265,414: Beers. Abnormal movement of plunger 4 into press mold, signals the operator so he may start motor to alter position of sleeve 7 so as to modify size of gob.

Patent 2,266,078 granted to Horace A. Robson of New Easwick near York, England (assigned to Crown Cork & Seal Co. Inc) is concerned with a suction gathering mold which inverts itself so that the sheared end of the charge will be at the base end of the parison mold instead of the neck end.

A take-out mechanism for machines such as those making large glass blocks is disclosed in patent 2,268,075 granted to George B. Langer of Anderson, Ind. (Lynch Corp.).

Figure 4 shows the general working plan of a press molding machine patented by Levi F. Goodrich of Corning, N. Y. (patent 2,267,236, Corning Glass Works). The eight stationary molds are charged from a continuously rotating gob distributing tube 12. As this approaches a given mold a guide member 13 directs the gob to the mold and then swings out of the way to allow the pressing plunger to form the ware. The small ware made by this press is ejected from the molds (after the halves have opened) by a blast of air which ejects them into a chute 18 from which they are delivered to a conveyor.

In patent 2,266,349 Bernard Wempe of Berlin, Germany, describes one aspect of his invention for preparing glass sheets or blocks pierced with tiny holes. (He refers to a copending application which seems to cover the broader aspects of his process.) He places tiny wires between two sheets of glass and then by heating and pressing forces the glass to entirely encompass the wires. Wempe then cuts the resulting block in a cross plane, and removes the wires by etching so as to give glass with the requisite number of tiny holes. He may use steel wires coated with rhodium so that after the steel is eaten away the holes will be lined with a chemically resistant layer caused by the fusion of the glass to the rhodium.

Patent 2,266,838, granted to Walter Winn of Brockway, Pa., utilizes two Geneva drives for a novel driving arrangement for a glass-forming machine having two rotatable tables.

Miscellaneous Processes

Two patents for machines for making filament supporting stems for electric lamps are 2,267,108 granted to James W. Juvinall of La Grange Park and Wm. B. Wines of Downers Grove, Ill. (Western Electric Co.), and 2,267,598 granted to Ralph B. Thomas of Beverly, Mass. (Hygrade Sylvania Corp.). The latter company was also assignee of Roland M. Gardner's patent, 2,267,727 for apparatus for baking internally coated fluorescent lamp tubing.

Other lamp-making processes are described in patents 2,265,359 granted to Mihály de Neumann of Budapest (General Electric Co.) and 2,264,496 to Otto R. Wollentin of Bloomfield, N. J., and Frederick T. May of Verona, N. J. (Westinghouse E. & Mfg. Co.). The de Neumann patent adds another to his group (previously including 1,977,671 and 2,014,471) concerning means of sealing lamps after they have been gas-filled to super-atmospheric pressure. One of the problems is to prevent the high pressure gas from glowing out through the area of glass which must be softened to make the seal. In the present instance the sealed tube and the heating elements which closed it are cooled before the latter are withdrawn. The Wollentin-May patent concerns a multiple station annular machine for automatically exhausting high-intensity mercury vapor lamps with the reported elimination of much hand labor.

A glass cutter with cutting wheels to simultaneously cut both layers of glass in a laminated sheet was patented by Walter and Harry Roberts of Denver (2,265,955). Patent 2,268,257 granted to Alfred W. Kobylinski of Creighton, Pa. (Pittsburgh Plate Glass Co.) also describes a cutting tool.

Inspection and testing devices were disclosed in three patents. These were 2,267,961 to Edgar D. Tillyer of Southbridge, and Carl B. White of Brimfield, Mass., for lens inspection (American Optical Co.), 2,268,098 to Paul Weathers of Audubon, N. J., for filled bottle inspection (Radio Corp. of America) and 2,268,238 to Maurice G. Bell of Detroit for judging the color intensity of colored plates (Pittsburgh Plate Glass Co.)

Sheet and Plate Glass

Toward avoidance of any air between the layers of laminated safety glass, Adolf Kämpfer of Berlin, Ger-

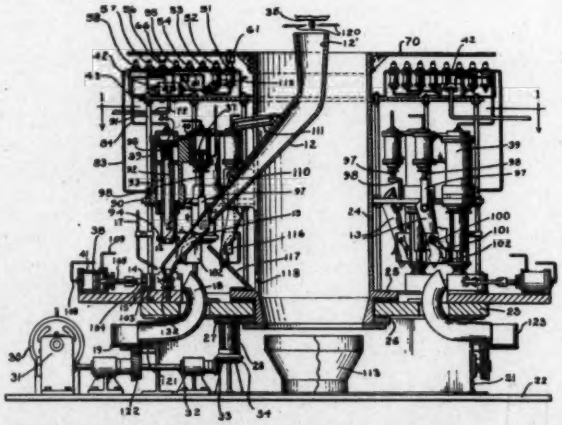


Fig. 4. 2,267,236: Goodrich. Small article press to which molds are charged from a continuously rotating gob-feeder-tube 12.

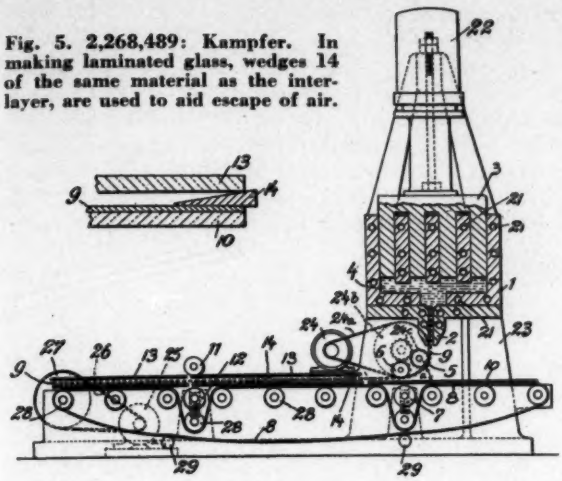


Fig. 5. 2,268,489: Kampfer. In making laminated glass, wedges 14 of the same material as the interlayer, are used to aid escape of air.

many, has devised means of bringing the several layers together at an acute angle (2,268,489). The assembled machine of Figure 5 shows, at the right, a press (such as was disclosed in Kämpfer's patent 2,154,133 of April 11, 1939) for the extrusion of a layer of plastic to be rolled immediately onto one of the glass sheets 10. The upper sheet is then put in place with tiny wedges 14 spaced at the sides of the sheets to hold them apart. These wedges shown in enlarged detail in the upper left-hand view are made of the same plastic as the bonding sheet. When pressure is applied to the pair of sheets to bond them at 11, the wedges serve to hold the "following edges" apart, and to keep an acute angle between the rolls. Apparently the wedges may be ejected by the pressure, although Kämpfer states that this is not necessary.

Joseph D. Ryan of Toledo in patent 2,268,266, assigned to Libbey-Owens-Ford Glass Co., also suggests a new process for making laminated safety glass, but his method uses only a heat treatment, and no pressure. He uses a preformed plastic sheet which he describes as being "under-plasticized," by which he means having a content of plasticizer considerably less than is desired in the final interlayer. He then applies a more highly plasticized coating, as by spraying, to both sheets of glass, its plastic nature being such as to allow it to immediately mold itself to the contours of the glass and of the preformed layer. The assembled laminated sheet is passed between rollers which yield enough pressure to expel the excess plastic but not enough to bond the sheets. Bonding is accomplished in a heating treatment which Ryan describes as rather prolonged. The major change taking place is the diffusion of the plasticizer throughout the preformed plastic sheet and plastic coating on the glass to bring about an equalization of plasticizer content. The invention is limited to no one type of plastic. As a result of the avoidance of high bonding pressure, it is stated that a characteristic of the product is the absence of internal strain as shown by examination by polarized light.

Libbey-Owens-Ford Glass Co. was assignee also of two patents granted to John L. Drake of Toledo. An apparatus for cutting a continuously formed sheet as it leaves the lehr was described in 2,267,605, while 2,267,604 of which Geo. R. Roesch was co-inventor, disclosed a sheet glass forming machine. The basic details are those of the Colburn process as described in patent 1,248,809, wherein a continuous ribbon of glass is drawn upwardly from a shallow working basin, and deflected over a bending roll and moved horizontally through an annealing lehr. The numerous improvements introduced by Drake inlude mechanism for mounting and driving the bending roll in such a way as to allow precise adjustment both vertically and horizontally, and also alteration of its speed.

Patent 2,268,247 issued to John H. Fox of Pittsburgh is an addition to the Pittsburgh Plate Glass Co. group involving means of producing colored sheet glass without emptying the ordinary colorless glass from the tank. One of their earlier patents suggested feeding colored glass onto the surface of the bath adjacent the line of draw of a Slingluff or Colburn machine. In this latest suggestion the molten colored glass is ladled into a hopper which feeds its product into a tank below the surface of the ordinary molten glass, at a point near the meniscus of the sheet. The normal line of flow over the submerged refractory drawbar, which controls the flow in this area, directs the colored glass directly to the drawing point.

Harold Perry and Augustus Wm. Grotefeld of Stone, England (Gilt Edge Safety Glass Ltd.), whose patent 2,199,511 for tempering sheet glass was reviewed in the July, 1940, GLASS INDUSTRY, were granted patent 2,265,308 as a division of the same subject matter. The sheets are tempered with water or another liquid cooling medium applied in atomized form.

Glass Wool and Fiber

The late Charles L. Norton, whose work while Director of the Division of Industrial Cooperation and Research at M.I.T. placed him among the pioneer workers in fiber glass manufacture, has received patent 2,265,742 (assigned to his executors) for a means of making slivers from a multiplicity of fibers. He illustrated his patent largely in terms of cellulose acetate, but stated that it applied also to fibers of glass. The fibers are formed at nozzle 14 from a large orifice (0.03 to 0.25 inch), which gives a flow large enough to make many fibers. E, at the extreme left, denotes a source of electric potential such as an electrostatic machine, one pole of which is grounded and the other connected with the nozzle 14 so as to electrify the fiber-forming liquid with an electrostatic charge of single polarity. Spaced from the nozzle is the collecting apparatus which comprises a support in the form of a drum or cylinder 19, which is rotated by an electric motor 20, and means for guiding the sliver onto a spindle 21. The collecting support is

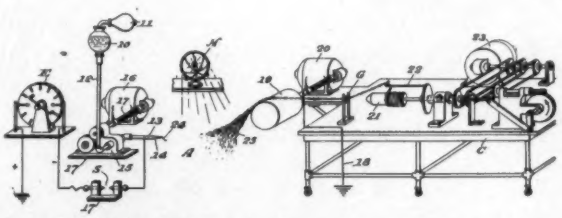


Fig. 6. 2,265,742: Norton. Fiber forming machine which utilizes heavy static charges to disintegrate a stream at nozzle 14 into numerous fibers, and to collect them at 25.

grounded so that it is electrified by a charge of opposite polarity and lower potential than that of the nozzle and the fibers formed from it.

Norton stated that when flow was started from the nozzle while the electrostatic machine was at rest, the liquid merely dripped from the nozzle, but when the electrostatic machine was likewise started the glass or other liquid was discharged from the nozzle "in the form of a tongue 24 in a state of rapid and violent agitation or vibration. . . ." "The material breaks up and is dispersed into fine particles which are at first almost invisible but which are drawn out and solidified into a wisp of fibers, somewhat repelled from one another, in a region spaced by an air gap A from the nozzle, as indicated at 25." It is reported that the fibers are immediately discharged of their initial electrostatic charge on engaging the support 19, and that they are readily drawn together to form a continuous sliver. The lightly induced charge of opposite polarity which the fibers obtain from the support 19 causes them "to attract the newly formed fibers and to be mutually repelled to form the brush-like tail 25. This electrostatic action also causes the tail 25 to be directed toward the nozzle 14 . . ., which combined with the effect of gravity on the fibers supported at their forward ends by the support 19, causes the tail to float in the formation region in a position (which allows it) to be progressively built up by newly formed fibers."

Two patents assigned to Owens-Corning Fiberglas Corp. were 2,265,186 granted to Piero Modigliani of Liverno, Italy, and 2,264,345 granted to Jesse L. Tucker and George M. Lannan of Newark, Ohio. Modigliani accumulates the fibers in a self-sustaining mat which is transferred to the spinning machine and cut into strips from which the fibers are spun. The Tucker-Lannan patent, pending for six years, states the inventors' belief that previously no sliver had been produced from parallel and untwisted fibers, which had sufficient tensile strength to permit it to be wound on spools or to withstand the strains incident to normal fabricating processes. Their method is that of continuously flowing and drawing a multiplicity of fine streams, causing them to solidify, collecting them on a conveyor in a mat in which the individual fibers are doubled back and forth, and continuously picking up the material from the mass at the same rate as accumulated, and drawing it through a funnel onto a winding spool. The steam blast which draws the fibers, whips them back and forth and attenuates them due to its turbulence, but yields fibers of great length.

Patent 2,267,019 granted to Wilhelm Esser of Bergedorf, Germany (assignor to the firm Oscar Gossler Glasgespinst-Fabrik Gesellschaft mit beschränkter Haftung, Bergedorf, Germany) describes a drawing apparatus for fiber glass manufacture. Patent 2,264,548, assigned by Gale T. Pearce of Somerville, N. J., to Johns-Manville Corp., concerns a mineral wool blowing nozzle.

Miscellaneous Products

Wm. O. Lytle of Pittsburgh assigned to Pittsburgh Plate Glass Co. his patent 2,268,258 for a reflector or highway marker in which the legend such as the word STOP is applied in vitreous enamel to the back of a sheet of tempered glass which is then reinforced with a layer of synthetic resin and subsequently shattered to provide unique reflecting surfaces.

In another Pittsburgh Plate Glass Co. patent, Elmer H. Haux of Tarentum provides a clay tile building block in which the normally hollow sections are filled with cellular glass (2,268,251).

Patent 2,268,168, assigned by Ronald E. Richardson of Oshawa, Ontario, to the Duplate Safety Glass Co. of Canada, Ltd., discloses a heat resisting mirror of borosilicate glass with an aluminum reflecting surface coated with a mixture of vitreous enamel and fine fused quartz, heated to such a temperature as will fuse the enamel but leave it inert to the aluminum.

"HOW MUCH ARE THEY GIVING?"

"How much are they giving?" asks one of the crew
On the speeding "E" machines,
As he fishes down for a dollar or two,
From the depths of his dusty jeans.

"How much are they giving?" another asks,
"The price of a dozen beers?"
As he loads his truck full of Fenwal flasks,
And wheels it off to the lehrs.

"How much are they giving?" The gatherer's paws
Stop not in their tireless twirl,
"Well, put me down. It's a worthy cause.
I'll give it another whirl."

"How much are they giving?" the gaffer thought,
As the blocker passed him a ball,
"A five? Or a ten? Yes, I really ought
To respond to THIS Red Cross call."

"How much are they giving?" No answer's heard
From the screeching air of the press,
From the clank of the Turret-Chain, no word,
Nor the click of the great "I-S."

"How much are they giving?" No answer came
From the clangor of Factory "A,"
But to each comes an answer that seems the same,
As if whispered from far away.

"How much are they giving?" That answer's waft
From the beaches of Lingayen,
From the burning ships and the smashed aircraft,
In the murmurs of dying men.

"How much are they giving?" The answer comes
Through the smoke of Manila's pall,
"How much are they giving?" No earthly sums,
Be still. They are giving ALL."

The above poem was written by a Corning Glass Works employee, who prefers to remain anonymous, for the Corning (N.Y.) Chapter, Red Cross War Fund Drive, and appeared in the January 9 edition of the *Evening Leader*, when that city was having its Red Cross Drive.

WANTED: Decorating Foreman. Should not be over 45 years of age, with ability to do etchings and all types of decorating. Reply Box 47, THE GLASS INDUSTRY, 11 West 42nd St., New York City.

Research Digest

Practical Interpretations of Glass Technology

The Coloring Effects of Certain Oxides

Preston and Turner, *Jour. Soc. Glass Tech.*, February, 1941, report some interesting conclusions as to the maximum quantities of certain oxides which may be present in an ordinary glass melted at 1400°C. (2500°F.) under slightly oxidizing conditions. The test pieces were polished disks 1″ in diameter and ½″ thick. The maximum quantities which can be tolerated are shown in the table:

Oxide	%
TiO_2	0.5 and probably greater
Cr_2O_3	0.001
V_2O_5	0.1
NiO	0.005
MnO_2	0.01
CoO	0.005
CuO	0.01

Perhaps the most interesting point brought out is that titania (TiO_2), which is often present as a slight impurity in sands, has no coloring effect in amounts as little as ½ of 1 per cent nor does it change in any way the coloring effect of the iron oxide present.

While not many of the other oxides, with the exception of manganese, are apt to be present in glass making materials, it is further of interest to note that the blue of cobalt is not apparent in these small pieces until its concentration reaches five parts per million. In decolorizing, to be sure, the amount of cobalt used is graduated much more finely, and most glass makers feel that the presence or absence of as little as one part per million in a decolorizer would become evident in the color of large pieces of ware.

The values in the above table are related inversely to the so-called "extinction coefficients" of the several elements. Thus, copper is ten times as strong as vanadium, chromium is ten times as strong as copper, and cobalt at least twice as strong as chromium.

Unfortunately, the authors did not take up directly the tolerable quantity of iron which could be present. However, in their decolorizing experiments they found that not more than 0.002 per cent chromium oxide could be concealed by decolorizing. Since it is probable that 0.05 per cent iron oxide in a glass will allow fairly good decolorizing, it follows that the coloring power of iron, at least under oxidizing conditions, is only about 1/25 that of chromium.

The Flow of Gases in Natural-Draft Furnaces

Anyone interested in the scientific operation and control of glass-melting furnaces would do well to read the paper by Gooding and Thring, *Jour Soc. Glass Tech.*, February, 1941. By means of elaborate studies with pressure gauges and pyrometers, the authors have been able to trace such matters as the distribution of hot gases and incoming air as they pass through regenerators and ports, and thereby to detect where the various resistances to flow may occur.

Of particular interest are the diagrams showing the temperature changes taking place in a regenerator during one complete cycle. This graph shows that a regenerator rises about 400°C. (700°F.) in the first five minutes of a thirty-minute half cycle. It cools the same amount in about ten minutes. This means that, for most of the time during which the checkers are preheating the air, the temperature is not as high as we generally suppose. Although the regenerators may reach a top temperature of 2350°F., they are operating below 1800°F. more than half of the incoming period.

Other interesting points brought out are the facts concerning the tendency of the incoming cold air to travel to the far end of the regenerator before rising by way of an up-take. This is especially true while a furnace is being heated up. In a hot furnace, there is some equalization, but it may not be assumed that all the ports on one side receive the same amount of air. Suggestions are made for structural changes, such as reducing the cross-section of the far ports or increasing the resistance of the checker work by closer packing, to adjust differences.

Numerous suggestions are made as to the instruments required and their application. Particular attention is paid to a suction type of thermocouple which will register gas (or air) temperatures without interferences from radiation.

Melting-Rate Studies

In any attempt to make use of the data presented by J. C. Potts (*Jour. Amer. Ceram. Soc.*, February, 1941) on the effect of composition and batch ingredients on melting rate, it must be borne in mind that he refers merely to the time required for the batch to become free from unmelted material. No attention is paid to the time required to finish the glass, bubble-free, and this is primarily and almost solely a function of viscosity, which may be increased or diminished by the various oxides and reagents concerned.

A few of the results are quite to be expected: soda, substituted for either silica or lime, is powerful in speeding up the melting, and its effect is almost proportional to amount substituted. Barium oxide or lime substituted for silica reduces the melting time abruptly for small substitutions, but the effect levels off at about 11 per cent for lime and at about 0.5 per cent for barium oxide, particularly where the lime content is high.

Boron oxide substituted for soda produces a minimum melting time at less than 0.5 per cent substitution. When it is substituted for silica, the melting time comes down abruptly but levels off at less than 0.5 per cent with very little further change. In order to discover the final effect of these oxides on finishing the glass, it would be necessary, of course, to know the changes in viscosity which these substitutions would produce.

When salt cake goes in for part of the soda ash, a very small amount causes a great reduction in melting time, but large substitutions first increase the melting time and then produce a new minimum when about ¼ of the soda ash has been replaced. The surprising effect of sodium nitrate replacing soda ash is that it increases the melting time. Fluorspar, although it very likely makes a more fluid glass later on, has almost no effect on the initial melting. (*Continued on page* 72)

CURRENT STATISTICAL POSITION OF GLASS

December witnessed continued record activity in the glass industry with employment and payrolls holding to recent high levels. According to THE GLASS INDUSTRY'S Production Index output during December totalled $43,000,000, bringing the year's total up to about $470,000,000. This record volume was 28 per cent greater than in 1940, and compares with $320,000,000 in 1939.

Plate glass production during December totalled 10,310,900 square feet, according to the Plate Glass Manufacturers of America. This was 27 per cent less than the previous month's volume and was 41 per cent below the December 1940 level. During the 12 months of 1941 plate glass production amounted to 190,403,612 square feet or 16 per cent more than the 1940 total of 164,371,570 square feet. This output was the largest since 1937 when the industry produced 192,592,000 square feet.

Window glass production during December amounted to 1,695,632 boxes—the greatest monthly output in the history of the industry. This was 31 per cent greater than the previous month's total and exceeded December 1940 by 13 per cent. Cumulative figures for the complete 12 months of 1941 indicate an output of 16,400,000 boxes or 20 per cent more than the 1940 figure. This represents a new production record for the window glass industry. During December this industry operated at 104.5 per cent of capacity.

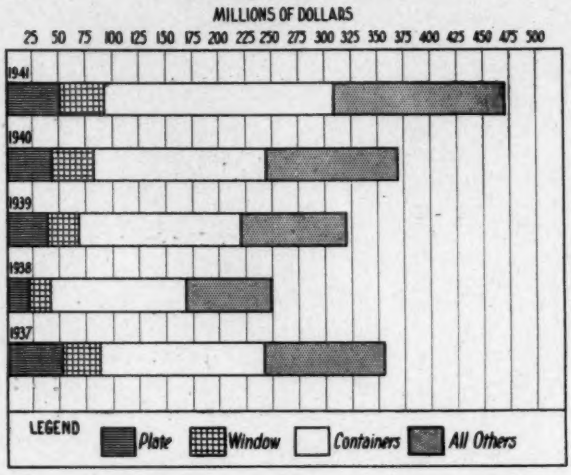
Glass container production during December totalled 6,050,260 gross, according to the Glass Container Association of America. This was 2 per cent less than the November total but exceeded December 1940 by 44 per cent. During the full 12 months of 1941 glass container output reached the record level of 70,440,010 gross which was 30 per cent greater than the previous record of 54,265,000 gross set in 1940.

Shipments of glass containers during December declined 8 per cent from the previous month's total to 4,902,584 gross; however, this was 39 per cent greater than in December 1940. Outstanding gains were reported over last year's corresponding month for beer bottles which increased 168 per cent, and domestic jelly glasses which expanded 177 per cent. Sales of pressure and non-pressure ware were up 76 per cent, domestic fruit jars 66 per cent, narrow-neck food containers 55 per cent, medicinal and toilet ware 50 per cent, general purpose ware 38 per cent, wide mouth food containers 27 per cent, milk bottles 24 per cent, pressed food ware 17 per cent and liquor ware 2 per cent. Cumulative figures for the full year of 1941 reveal that shipments exceeded the 1940 volume by 3[illegible] per cent, establishing the record total of 68,961,339. Analysis of the trends in individual lines indicates that all types of containers have made substantial gains—domestic fruit jars 96 per cent, beer bottles 60 per cent, pressure and non-pressure ware 45 per cent, domestic jelly glasses 40 per cent, general purpose ware 30 per cent, milk bottles 33 per cent, wide mouth food containers 29 per cent, medicinal and toilet ware 38 per cent, narrow-neck food containers 24 per cent, liquor ware 21 per cent, and pressed food ware 20 per cent.

Inventories of glass containers were 3 per cent lower at the close of 1941 than they were at last year's corre-

THE GLASS INDUSTRY'S INDEX

Production: Twelve Months, January Through December



CURRENT GLASS CONTAINER STATISTICS

(ALL FIGURES ARE IN GROSS)

Types of Ware	Production		Shipments		End of Month Stocks	
	Dec., 1941	Dec., 1940	Dec., 1941	Dec., 1940	Dec., 1941	Dec., 1940
Food Container (Narrow neck. wide mouth, and pressed)	1,341,921	904,068	1,121,817	852,766	2,371,828	2,199,900
Pressure and Non-Pressure	387,215	256,409	331,627	189,363	616,186	785,260
Beer	411,356	178,180	397,700	154,070	390,072	590,031
Liquor	1,023,193	1,050,824	834,365	803,121	1,945,234	1,766,855
Medicine and Toilet Prep	2,032,970	1,256,763	1,580,103	1,040,396	3,072.074	3,129,420
General Purpose	429,910	300,511	372,095	267,121	479,620	704,007
Milk	271,761	186,131	244,570	198,016	365,833	314,344
Fruit and Jelly	133,159	44,864	4,271	2,512	400,641	454,613
All Other	18,775	19,926	16,036	18,242	41,920	36,686
Total Industry	6,050,260	4,197,676	4,902,584	3,525,607	9,683,408	9,981,116

sponding date. Stocks of all types of ware declined with the exception of food containers, liquor ware, milk bottles and domestic jelly glasses which increased.

Miscellaneous glass products manufactured during December were valued at $18,000,000 as compared with $14,000,000 in December 1940. The output of this branch of the industry in 1941 was estimated at $164,000,000 or an increase of 29 per cent over 1940's production estimate of $127,000,000.

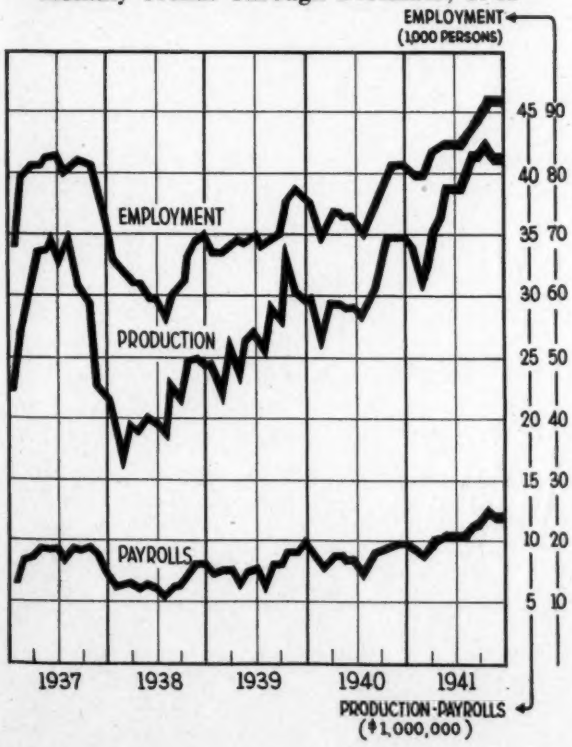
Machine-made tumbler production during December amounted to 4,346,135 dozens, which was 36 per cent greated than in 1940's corresponding month. 1941's total production of these items amounted to 53,005,615 dozens—22 per cent above the previous year's level. Shipments during December increased 13 per cent over December 1940 to 3,236,428 dozens, bringing the month's total 22 per cent above 1940's volume to 51,337,606 dozens. By the close of 1941 finished stocks of tumblers rose 6 per cent above the 1940 level to 8,936,310 dozens.

Manufacturers' sales of machine-made table, kitchen and household glassware during December totalled 2,552,824 dozens or 4 per cent more than in 1940's corresponding month. Total sales for the full year of 1941 increased 16 per cent over 1940 to 39,085,634 dozens.

Sales of illuminating glassware gained 28 per cent in December over the same month in 1940, according to reports of 11 manufacturers to the Bureau of Census. This same source reports that for the full year of 1941, illuminating glassware sales were one-third greater than 1940.

GI THE GLASS INDUSTRY'S INDEX

Monthly Trends Through December, 1941



Employment and Payrolls: Employment in the glass industry during December held to the 93,000 persons reported for November. This compares with 81,500 persons in December 1940. It is estimated that the average number employed in the glass industry during 1941 approximated 87,000 persons.

Payrolls in the glass industry during December equalled the November figure of $12,500,000. Glass manufacturers paid out close to $135,000,000 in wages during 1941 as compared to $104,000,000 in 1940 and $90,000,000 in 1939.

AUTOMATICALLY FOCUSED LENS

A four-element motion picture lens has been designed by Bausch & Lomb Optical Co., in which one double-concave element is electronically oscillated on its axis by means of a special cell mounting developed by P. Stanley Smith, a New York radio engineer. The new lens is confined to a distance of three-tenths of a millimeter in its axis movement but the oscillations are at the rate of 23,200 times per minute, thus continuously altering the focus so that all objects are uniformly in register from four feet to infinity. Although all objects are slightly softer than with lenses of a fixed focal length, many photographers regard this as an improvement.

Smith, following the work of Dr. Ludwig Dieterich, an Austrian-born engineer, who patented a mechanical method for vibrating a lens element, designed an electronic method of achieving this purpose and has successfully incorporated the lens in a motion picture camera which it is believed will offer greater flexibility in motion picture photography and direction. At present action must be kept mobile within the set focus of the camera. Actors must work within a chalk line necessitated by the focal range of the camera. Lighting must be rearranged for each new focus, cameras reset, and distances taped.

The new electroplane camera, with a lens which keeps all moving objects in perpetual focus, holds the promise of a solution to one of the chief limitations in motion picture photography. Bausch & Lomb engineers stated that the new oscillating lens could not be incorporated in hand cameras.

EXPANSIVITY OF A VYCOR BRAND GLASS

A study of a new glass (96 per cent silica, glass No. 790) used in heat-resisting glassware was made a short time ago by James B. Saunders, and the results are given in the *Journal of Research* for January (RP1445). The expansivity of the glass is compared with that of fused quartz, using a slight modification of Fizeau's method for determining very small differences in expansion. This method has the advantage of permitting the use of relatively long samples, the procurement of very sharp and well-defined interference bands, and the almost complete elimination of the correction arising from changes in the refractive index of air with changing temperature.

The results indicate that the No. 790 glass has a coefficient of expansion approximately twice that of fused quartz at room temperature, an expansivity equal to fused quartz at approximately 300°C. (572°F.), and an expansivity less than one-half of that for fused quartz in the neighborhood of 700°C. (1292°F.).

CURRENT PRICES OF GLASS-MAKING MATERIALS

FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS

Base Materials

	Carlots	Less Carlots
Barium carbonate ($BaCO_3$), Crude, (Witherite)		
90%, 99% through 200 mesh....ton	....	....
Precipitated material....ton	55.00	60.00
Barium sulphate, in bags....ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point....ton	15.00-16.00	18.00
Borax ($Na_2B_4O_7 10H_2O$)....lb.	....	....
Granulated....In bags, lb.	.0225	.028 -.0305
Powdered....In bags, lb.	.025	.0305-.033
Boric acid (H_3BO_3) granulated....In bags, lb.	.0495	.0555-.058
Calcium phosphate ($Ca_3(PO_4)_2$)....lb.	.07	.07½
Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith)....lb.	.950-.975	.10
Synthetic (Artificial)....lb.	No supplies available.	
Feldspar—(published list prices)		
20 mesh....ton	11.00-13.25	
40 mesh....ton	11.50-13.75	
Granular....ton	11.75-14.00	
Semi-granular....ton	11.00-13.25	
L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags.		
Fluorspar (CaF_2) domestic, ground, 96-98% (max. SiC_2, 2½%)		
Bulk, carloads, f. o. b. mines....ton	34.00	....
In bags....ton	36.40	50.00
Kryolith (see Cryolite)		
Lead Oxide (Pb_3O_4) (red lead) (N. Y.)....lb.	.0835	....
In 5 Ton lots....lb.	....	.0950
Less than 5 Tons....lb.	....	.10
Lime—		
Hydrated ($Ca(OH)_2$-MgO) (in paper sacks).ton	8.50	10.50
Burnt (CaO-MgO) ground, in bulk....ton	7.50	....
Burnt, ground, in paper sacks....ton	9.50	9.50
Burnt, ground, in 280 lb. drums....Per drum	2.35	2.35
Kiln Dried ($CaCO_3$-$MgCO_3$) 10x30 mesh..ton	2.00	....
Kiln Dried ($CaCO_3$-$MgCO_3$) 16x20 mesh..ton	2.00	....
Nepheline Syenite, f. o. b. shipping point....ton	12.50	16.00
Potassium carbonate—		
Calcined (K_2CO_3) 96-98%....lb.	.065	.0675
Hydrated 80-85%....lb.	.055	.0575
Salt cake, glassmakers (Na_2SO_4) in bags....ton	21.00-22.00	28.00-30.00
in bulk....	17.50	
Soda ash (Na_2CO_3) dense, 58%—		
Bulk....Flat Per 100 lb.	.95	....
In barrels....Per 100 lb.	1.35	....
In Paper bags....Per 100 lb.	1.10	....
In Burlap bags....Per 100 lb.	1.15	....
Sodium nitrate ($NaNO_3$)—		
Refined (gran.) in bbls....Per 100 lb.	....	3.00-3.40
95% and 97%		
Bulk....Per 100 lb.	1.35	3.60-4.00
200 lb. bags....	1.4675	1.48
100 lb. bags....	1.475	1.50

Special Materials

	Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)....lb.	.031-.034	.045
Aluminum oxide (Al_2O_3)....lb.	.07	.09
Antimony oxide (Sb_2O_3)....lb.	.15	.15½-16½
Arsenic trioxide (As_2O_3) (dense white) 99%....	....	.04½-.04¾
Barium nitrate ($Ba(NO_3)_2$)....lb.	....	Open price.
Pyrophyllite, (20% Al_2O_3)....ton	10.00	13.00
Sodium fluosilicate (Na_2SiF_6)....lb.	....	15.00
Tin Oxide (SnO_2) in bbls....lb.	....	Open price
Titanium Oxide (ceramic grade) (Priority)		
In bags....lb.	....	....
In barrels....lb.	....	....
Zinc Oxide (ZnO)		
American process, bags....lb.	.07¼	.07½
White Seal, 150 lb. bbls....lb.	.09¾	.10
Green Seal bags....lb.	.09	.09¼
Domestic White Seal bags....lb.	.09½	.09¾
Red Seal, bags....lb.	.08½	.08¾
Zircon		
Refined Granular (Milled .01-.02c. higher) .	.06½	.07-.08

Coloring Materials

	Carlots	Less Carlots
Barium selenite ($BaSeO_3$)....lb.	....	1.40-1.60
(Commercial, 25% Selenium)....lb.	....	.85
Cadmium sulphide (CdS)....lb.	....	1.10-1.15
Cerium hydrate—		
100 lb. drums and 600 lb. barrels....lb.	....	.60
Chrome Oxide Green, 400 lb. bbls....lb.	....	.25-.28
Chromite (99% through 200 mesh)....ton	58.25	64.75
Chromite ore (air floated)....ton	58.25	64.75
Cobalt oxide (Co_2O_3)		
In bbls....350 lbs. or more, lb.	....	1.84
Less than 350 lbs., lb.	....	1.94
Copper oxide—		
Red (Cu_2O)....lb.	....	.20-.22
Black (CuO)....lb.	....	.19-.22½
Black prepared....lb.	....	Open price
Iron Oxide—		
Red (Fe_2O_3)....lb.	....	.06-.10
Black (Fe_3O_4)....lb.	.04½	.09
Iron Chromate....lb.	....	.035-.05
Lead Chromate($PbCrO_4$) in bbls....lb.	....	.16
Lithium Carbonate....lb.	....	1.25
Manganese, Black Oxide (Caucasian)		
In Paper bags....ton	70.00	78.00
In Burlap bags....ton	71.75	79.75
In Casks....ton	74.00	82.00
Neodymium oxalate, 50 lb. drums....lb.	....	4.00
Nickel oxide (Ni_2O_3), black....lb.	....	35-.40
Nickel monoxide (NiO), green....lb.	....	.35-.37
Potassium bichromate ($K_2Cr_2O_7$)—		
Crystals and Granular....lb.	.09½	.09¾-.10
Powdered....lb.	....	.10¼-.10½
Potassium Chromate (K_2CrO_4) 100 lb. kegs...lb.	....	.27
Powder blue....lb.	....	.21-.25
Rare earth hydrate—		
100 lb. drums....lb.	....	.35
325 lb. barrels....lb.	....	.30
Selenium (Se) In 100 lb. lots....lb.	....	1.75
In lesser quantities....lb.	....	1.85
Sodium bichromate ($Na_2Cr_2O_7$)....lb.	.07¼	.07½-.07¾
Sodium chromate (Na_2CrO_7) Anhydrous....lb.	.08⅝	.08⅞-.09⅛
Sodium selenite (Na_2SeO_3)....lb.	....	1.50-1.65
Sodium uranate (Na_2UO_4) Orange....lb.	....	1.65
Yellow....lb.	....	1.65
Sulphur (S)—		
Flowers, in bbls....Per 100 lb.	3.40	3.75-4.15
Flowers, in bags....Per 100 lb.	3.05	3.40-3.80
Flour, heavy, in 250 lb. bags....Per 100 lb.	2.95	3.30-3.70
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black....lb.	....	2.55
Yellow orange....lb.	....	1.65

Polishing Materials

	Carlots	Less Carlots
Emery, Turkish....lb.	.075	.08
Pumice Stone,		
American Ground FFF, FF, F....lb.	.03	.04
0, 0½, ½, 1....lb.	.05¾	.05¾
Putty Powder....lb.	Open price.	
Rotten Stone, (Domestic)....lb.	.02¼	.03½
Rouge, Red....lb.	.18	.16
Black....lb.	.15	.18

"Ceramic's NEW COBALT PLANT is now in full production

1

2

3

3. Four of the huge lead-lined tanks used in some of the first steps in the treatment of Cobalt ore. The capacity of these 4 tanks alone is almost 40,000 gallons of material.

2. One of the large filter presses used in Cobalt Sulphate processing. This particular press contains 48 plates 48" square.

1. A section of the Cobalt plant showing some of the tanks, filter presses, agitators, pumps, etc., used in separating impurities from the original Cobalt ore.

• "Ceramic's" Cobalt refining plant, designed and erected by "Ceramic" engineers, has been in operation since February 1941 and is currently producing approximately 20,000 pounds of Cobalt Oxide and 8,000 pounds of Cobalt Sulphate per month.

This entire project, the first to be undertaken by a ceramic chemical house on a large commercial scale, is solely for the purpose of insuring a constant supply of Cobalt Oxide to American industry.

This is just another example of "Ceramic's" progress and cooperation with the ceramic industry.

GLASS COLORS

Alkali Resisting
Acid Resisting
Weather Resisting Enamels
Satin Finish
Squeegee
Screening
Banding
Spraying
High Fire Convexing
Low Fire
Decalcomania Colors
Batch Colors
Crystal and Colored Ices

CHEMICALS

Aluminum Hydrate
Antimony Oxide
Arsenic Oxide
Barium Carbonate
Barium Sulphate
Bone Ash
Cadmium Sulphide
Cerium Hydrate
Chromium Oxide
Cobalt Oxide
Copper Oxide
Cryolite
Fluorspar
Iron Chromate
Iron Oxides
Manganese Dioxide
Nickel Oxide
Powder Blue
Potassium Bichromate
Selenium
Sodium Selenite
Sodium Silico Fluoride
Sodium Uranate
Titanium Dioxide
Zinc Oxide
Zirconium Oxide

OILS

Balsam Copaiba
Oil of Copaiba
Damar Varnish
Venice Turpentine
French Fat Oil
Ground Laying Oil
Squeegee Oils
Printing Oils

"Ceramic" COLORS
CERAMIC COLOR & CHEMICAL MFG. CO.
NEW BRIGHTON, PA., U.S.A.

NEW EQUIPMENT AND SUPPLIES

MATHIESON CELEBRATES ITS FIFTIETH ANNIVERSARY

Fifty years ago American glass makers had to import most of their soda ash from England. Little of the soda ash then being made in this country was considered suitable for glass making, and the glass industry was compelled to look to foreign producers to obtain the special quality it needed.

Since soda ash is one of the glass maker's major raw materials, this dependence upon imported supplies was both costly and inconvenient. A domestic source of the proper grade of soda ash was badly needed and, because of that need primarily, the Mathieson Alkali Works was founded.

The site selected for the new soda-ash plant was Saltville, Virginia, where there was an abundant supply of salt and limestone, the necessary raw materials; and, to insure a product that would meet glass makers' requirements, chemical engineers and experienced workers were brought over from England to supervise the construction and equipment of the plant and start it in operation.

The plant, which was completed in 1895, was well situated to serve the majority of glass makers. Then history repeated itself. Glass works began to spring up in Oklahoma, Texas, and other southwestern states, and these, in turn, needed a local supply of soda ash. So, in 1935, Mathieson began production of this chemical at Lake Charles, Louisiana, which is in the center of a rapidly growing industrial area.

The raw materials used by the Lake Charles plant are of extreme purity. The salt is piped in the form of brine from the West Hackberry Salt Dome, a mass of almost chemically pure salt, several miles in diameter and hundreds of feet thick. The lime is obtained by calcining oyster shells which lie by the billions at the bottom of Lake Calcasieu, a body of water on which the plant is located.

Though Mathieson is celebrating its fiftieth anniversary, it is not taking time out to do so; it is too deeply involved in turning out chemicals that are needed for war and for the operation of American industries.

FIRST COBALT PLANT IN U.S.

Previous to the present war, Europe was producing between 80 and 90 per cent of all the Cobalt Oxide manufactured in the world, with Belgium plants alone producing approximately 60 to 70 per cent of the world output of Cobalt Metal, Cobalt Oxide and Cobalt Sulphate. After the war started, shipments of ore to the European refining plants were discontinued, and after the invasion of Belgium, the largest producing units of Cobalt Oxide and Cobalt Sulphate were completely destroyed. At that time there was probably a six to eight months' supply of cobalt materials located in various parts of Europe and the United States.

The Ceramic Color and Chemical Manufacturing Company of New Brighton, Pennsylvania, recognized this condition and plans for a cobalt refining plant were immediately drawn. Ground was broken early in the summer of 1940 and a plant was constructed at a cost of approximately $100,000. This plant went into operation in February 1941, and today is producing approximately 20,000 pounds of Cobalt Oxide and 8,000 pounds of Cobalt Sulphate per month.

The design, construction and operation of the Ceramic cobalt plant was handled entirely by "Ceramic" engineers. Equipment was designed, installed and operated with very few changes. Cobalt Oxide was being manufactured at an exceptionally early date. Several tanks of 10,000 gallon capacity had to be constructed and installed. Where it was necessary to use metal tanks, they were all lead lined and over fifty tons of lead were used in this process. Special duriron valves were also necessary in this construction. Where it was possible, huge cypress tanks were used with specially constructed filter presses also installed.

The Ceramic Color and Chemical Manufacturing Company has the distinction of being the first ceramic chemical house to produce Cobalt Oxide in this country on a large commercial scale, and the Cobalt Oxide produced not only goes into the enamel, glass and pottery industries, but a good portion is also used in the manufacture of alloys for tool steel and high speed steel for airplane motors.

PORTER-CABLE BELT GRINDER

As a new addition to their line of wet and dry abrasive Belt Grinders, the Porter-Cable Machine Company of Syracuse, N. Y., announces a small abrasive belt sander-grinder using a belt 4 in. wide by 45 in. in circumference. This grinder is so equipped that it may be used either with dry belts or with the new type, resin bonded abrasive belts on which water or other coolant is sprayed. A ¾ H.P., 1725 R.P.M. ball bearing, totally enclosed motor, directly connected to the drive pulley of grinder, gives a belt speed of 3400 surface feet per minute, traveling over a flat backing plate 4 in. wide by 10 in. long, allowing a working surface of 40 sq. in. Two convenient hand adjustments simplify the application, removal and alignment of abrasive belts. A removable side guard exposes the entire interior. The cast iron pedestal on which the complete unit is mounted is substantial yet light enough to make the machine readily portable. A position change from vertical to horizontal, or even horizontal with the belt underneath can be quickly made by removing three bolts. The slotted rest table is adjustable up to a forty-five degree angle.

The Type G-4 is recommended for sanding or grinding small parts composed of wood, metals, plastics, glass, fibre, hard rubber, and other materials where a clean, uniform surface is desired, pieces to be squared or radii to to be generated. It will also handle many light milling and grinding operations without the use of fixtures, thus saving lock up and tool travel time over voids in scattered areas.

PENNSALT PROMOTION

Announcement has just been made of the promotion of George B. Beitzel from manager of sales to vice president in charge of sales of the Pennsylvania Salt Manufacturing Company, Philadelphia, Pa., manufacturers of chlorine, caustic soda, ammonia, hydrogen peroxide, and other chemical products, and importers of Greenland Cryolite. He was educated in the public schools of Philadelphia and in the University of Pennsylvania. He served his country in the first World War, advancing through the ranks from private to first lieutenant. After the war he spent a number of years with John T. Lewis & Bros. Company, paint manufacturers, and twelve years ago came to the Pennsylvania Salt Manufacturing Company.

CATALOGS RECEIVED

A. P. Green Fire Brick Co., Mexico, Mo. A folder on "Greencote"; a refractory maintenance coating for reconditioning furnace linings.

Brown Instrument Co., Philadelphia, Pa. A new calendar for 1942. This new calendar portrays the varied problems encountered in modern industrial processes by a series of original cartoons. The drawings have been reproduced in four colors to keep them as similar to the originals as possible. Along with the cartoons are included photographs and descriptions of the various instruments and control devices manufactured by Brown.

Chain Belt Co., Milwaukee, Wis. Bulletin No. 410 on "Rex" bulk handling conveyor. Also in this catalog is information and pictorial descriptions of "Rex" belt conveyors, apron conveyors and bucket elevators.

CATALOG & BULLETIN SERVICE

Current catalogs and manufacturers' service bulletins reviewed in this department may be obtained by writing to THE GLASS INDUSTRY.

MADE FOR EACH OTHER . . .

• When customers tell us their products and Drakenfeld colors seem to have a natural affinity for each other, we can only bow in gracious appreciation and pass the word along to you.

A share of the same profitable experience can be yours, for once our technologists work out a color problem with you, that color is yours and ours for keeps.

Drakenfeld technologists put into every color problem not only the priceless experience we have gained during the past 73 years, but the latest scientific knowledge as well. Add to this rigid control in every phase of color manufacture and you are assured of fewer rejects, savings in time, materials and profits.

Find out what Drakenfeld can do to help you solve color problems, and attain faster, more economical production. Write today.

B. F. DRAKENFELD & CO., INC., 45-47 Park Place, New York, N. Y.
Branch: Chicago, Ill. : *Works:* Washington, Pa. : *Pacific Coast Agents:* Braun Corp., Los Angeles : Braun-Knecht-Heimann Co., San Francisco

DEPENDABLE SERVICE ON

Acid, Alkali, and Sulphide Resistant Glass Colors and Enamels

Crystal Colored Ices

Squeegee Oils and Mediums

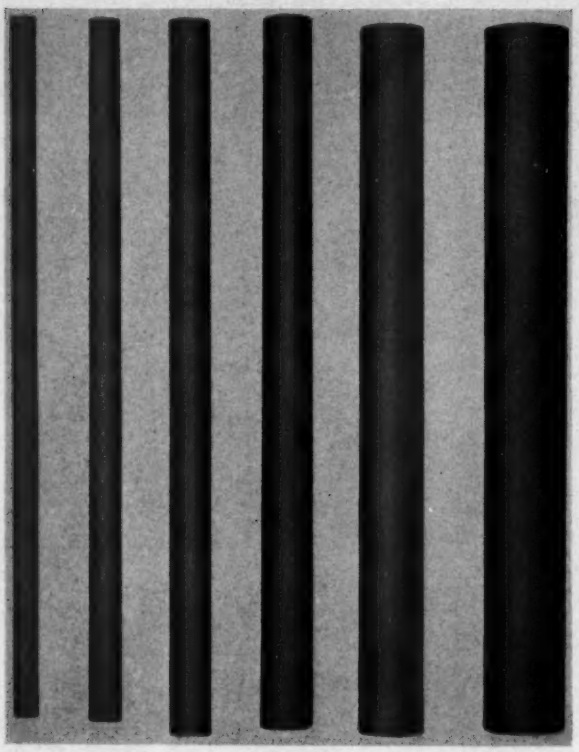
Metallic Oxides and Chemicals

Gold, Silver, Platinum and Lustre Preparations

Supplies

DRAKENFELD

Malleable Iron Rods for plugging Moulds



1/8" 3/16" 1/4" 5/16" 3/8" 1/2" 5/8" x 6"

IN the manufacture of Malleable Rods a "white iron" is produced Fe3C. The carbon is present in the combined form. The "white iron" castings are annealed or graphitized so that the final structure consists of ferrite (Fe) and free carbon (C) which is in the form of "temper" carbon.

This material is very soft and will pein readily.

Machinability

It is generally known, in commercial operations, Malleable iron machines more readily than other ferrous materials of equal tensile properties.

May we send you a descriptive booklet or answer questions on your specific problems?

Price of 15c per lb. F.O.B. Rockford effective Feb. 1st.

GUNITE FOUNDRIES CORPORATION

ROCKFORD ILLINOIS

Established 1854

THE TOLEDO TRIAL

(*Continued from page 60*)

In another stipulation, agreed to by the government in place of the testimony of Urban E. Bowes, director of research for Owens, Mr. Middleton presented further figures to show exactly what Owens spent in the cost of engineering, development and experimental work in the Packaging Research Department for the years 1930 to 1940. These figures are aside from the money spent in physical improvements and the calendar is as follows: in 1930 the company spent $28,763 in packaging research; in 1931, $26,582; 1932, $29,249; 1933, $25,288; 1934, $33,088; 1935, $44,356; 1936, $52,086; 1937, $105,026; 1938, $133,311; 1939, $154,822 and 1940, $164,755.

In the final sessions of testimony by Hartford-Empire witnesses a miniature glass feeding machine was exhibited in the courtroom and Col. R. D. Brown, vice president and patent counsel for Hartford, explained its workings. He pointed out on the miniature the numerous patents the Hartford-Empire Co. developed for use in the machine and separated them from the patents acquired from other inventors.

During the last week of the taking of testimony Judge Kloeb ordered longer court hours to speed the procedure. Originally court was held from 10 a.m. to 4:30 p.m. He advanced the time to from 9 a.m. to 5 p.m.

At the adjournment James Green, federal court clerk, was in possession of more than $1,800,000 in royalties ordered impounded by Judge Kloeb at the beginning of the trial.

RESEARCH DIGEST

(*Continued from page 65*)

Durability

Last month we commented on a paper by Bacon and Burch. These authors presented further data in the *Jour. Amer. Ceram. Soc.*, January, 1941. After an exhaustive series of tests on bottles of eleven different compositions, using distilled water, very dilute acid, and very dilute alkali as extracting media, at various temperatures, and for times up to one year, they are able to arrive at certain interesting conclusions.

In the light of this highly instructive report, any glass manufacturer concerned with the problem of testing his bottles to meet the requirements of different consumers would do well to bear in mind certain fundamental considerations:

1. When glass is tested with water, the water immediately begins to become alkaline as soon as any attack takes place, and the concentration of alkali steadily increases, so that testing by water amounts to testing with an alkaline solution.

2. Testing by dilute acid gives no indication of the behavior of the bottle against water or an alkaline solution that may be stored in it.

3. Testing by means of an alkaline solution is the severest test of all, and bears no relation to the subsequent behavior of the bottle unless it is to be used for the storage of an alkaline solution.

4. The glass itself is not the only consideration, but the size, shape and storage history—that is, age of the

bottle, and the humidity of the atmosphere in which it has been stored—all have some bearing on the results of testing.

All this is more or less repetition; however, the point can not be too strongly emphasized that no accelerated test has yet been devised, nor seems likely to be devised, which will demonstrate with any degree of certainty the suitability of a given bottle for the continued storage of any and all sorts of liquid. Much can be demonstrated in a general way about the probable durability of a given glass composition when it has been made into a bottle. But the actual service or performance test remains the ultimate check on any rapid laboratory estimate of durability.

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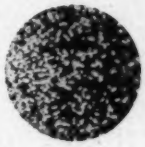

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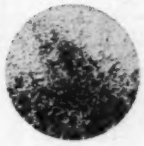

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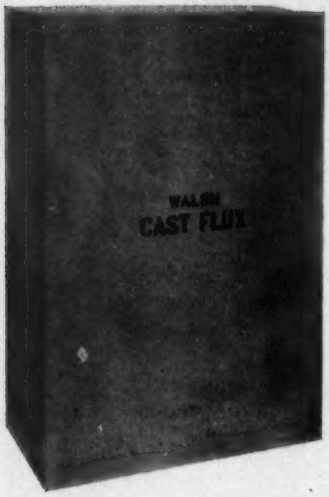

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